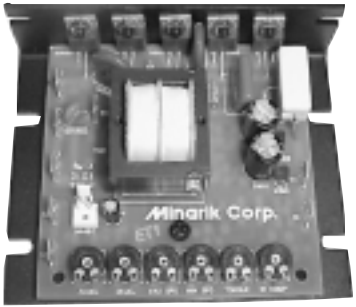
Minarik Automation & Control

MM20000 Series



Models:

MM21000A
MM21001A
MM21010A
MM21011A
MM22000A
MM22001A
MM22011A

SCR, Adjustable Speed Drives for DC Brush Motors

User's Manual

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Printed in the United States of America.

Safety Warnings

- This symbol ⚠ denotes an important safety tip or warning. **Please read these instructions carefully** before performing any of the procedures contained in this manual.

- **DO NOT INSTALL, REMOVE, OR REWIRE THIS EQUIPMENT WITH POWER APPLIED.** Have a qualified electrical technician install, adjust and service this equipment. Follow the National Electrical Code and all other applicable electrical and safety codes, including the provisions of the Occupational Safety and Health Act (OSHA), when installing equipment.

- Reduce the chance of an electrical fire, shock, or explosion by proper grounding, over-current protection, thermal protection, and enclosure. Follow sound maintenance procedures.

⚠ **It is possible for a drive to run at full speed as a result of a component failure.** Minarik strongly recommends the installation of a master switch in the main power input to stop the drive in an emergency.

Circuit potentials are at 115 VAC or 230 VAC above earth ground. Avoid direct contact with the printed circuit board or with circuit elements to prevent the risk of serious injury or fatality. Use a non-metallic screwdriver for adjusting the calibration trimpots. Use approved personal protective equipment and insulated tools if working on this drive with power applied.

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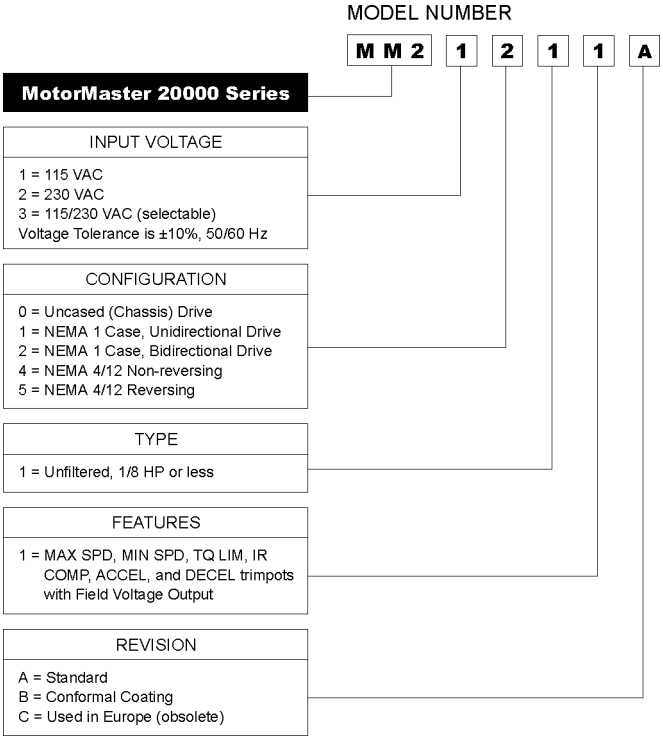
MM20000 Series Numbering System



Specifications

Model	Max. Input Voltage (AC)	Max. Input Current (Amps AC)	Armature Current (Amps DC)	HP Range	Style
MM21000A	115	3	5*	1/8 – 1/2*	Chassis
MM21001A	115	3	5*	1/8 – 1/2*	Chassis
MM21010A	115	3	1.5	1/20 – 1/8	Chassis
MM21011A	115	3	1.5	1/20 – 1/8	Chassis
MM22000A	230	3	5**	1/4 – 1**	Chassis
MM22001A	230	3	5**	1/4 – 1**	Chassis

*Max HP = 1 and max armature current = 10A if mounted on 223-0159 heat sink.

**Max HP = 2 and max armature current = 10A if mounted on 223-0159 heat sink.

AC Line Voltage Tolerance	±10%, 50/60 Hz, single phase
Armature Voltage	
115 VAC line voltage	0 – 90 VDC
230 VAC line voltage	0 – 180 VDC
Field Voltage (1 ADC max)	50 – 100 VDC
Maximum Output Field Current	1 ADC
Form Factor	1.37 at base speed
Accel. Time Range	0.5 – 11 seconds
Decel. Time Range	coast to a stop – 13 seconds
Analog Input Voltage Range (signal must be isolated; S1 to S2)	
0 – 90 VDC Motors	0 – 1.4 VDC
0 – 180 VDC Motors	0 – 2.8 VDC
Input Impedance (S1 to S2)	100K ohms
Load Regulation	1% base speed or better
Vibration	0.5G max (0 – 50 Hz) 0.1G max (>50 Hz)
Ambient Temp. Range	10°C – 55°C

Dimensions

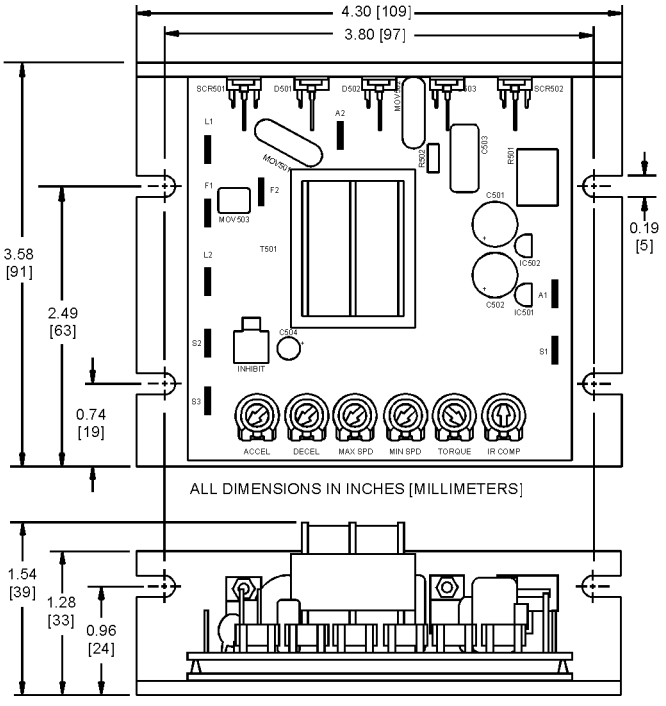
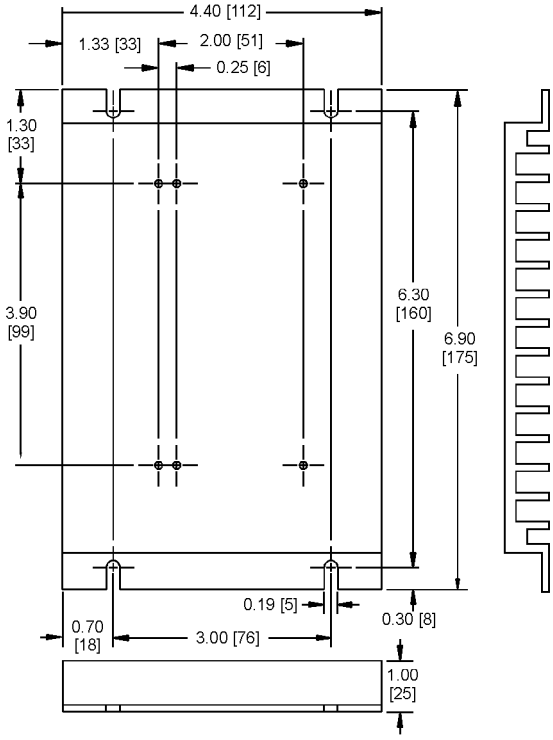


Figure 1. Dimensions



ALL DIMENSIONS IN INCHES [MILLIMETERS]

Figure 2. 223-0159 Heat Sink Dimensions

Installation

Mounting

Warning

Do not install, rewire, or remove this control with power applied. Doing so may cause fire or serious injury. Make sure you have read and understood the Safety Warnings on page i before attempting installation.

The chassis must be earth grounded. Use a star washer beneath the head of at least one of the mounting screws to penetrate the anodized chassis surface and to reach bare metal.

- Drive components are sensitive to electrostatic fields. Avoid direct contact with the circuit board. Hold drive by the chassis only.
- Protect the drive from dirt, moisture, and accidental contact. Provide sufficient room for access to the terminal block and calibration trimpots.
- Mount the drive away from heat sources. Operate the drive within the specified ambient operating temperature range.
- Prevent loose connections by avoiding excessive vibration of the drive.

Wiring

Warning

Do not install, remove, or rewire this equipment with power applied. Failure to heed this warning may result in fire, explosion, or serious injury.

Circuit potentials are at 115 or 230 VAC above ground. To prevent the risk of injury or fatality, avoid direct contact with the printed circuit board or with circuit elements.

Do not disconnect any of the motor leads from the drive unless power is removed or the drive is disabled. Opening any one motor lead may destroy the drive.

Use 18–24 AWG wire for speed adjust potentiometer wiring. Use 14–16 AWG wire for AC line (L1, L2), field (F1, F2) and motor (A1, A2) wiring.

Shielding guidelines

Warning

Under no circumstances should power and logic leads be bundled together. Induced voltage can cause unpredictable behavior in any electronic device, including motor controls.

As a general rule, Minarik recommends shielding of all conductors.

If it is not practical to shield power conductors, Minarik recommends shielding all logic-level leads. If shielding logic leads is not practical, the user should twist all logic leads with themselves to minimize induced noise.

It may be necessary to earth ground the shielded cable. If noise is produced by devices other than the drive, ground the shield at the drive end. If noise is generated by a device on the drive, ground the shield at the end away from the drive. Do not ground both ends of the shield.

If the drive continues to pick up noise after grounding the shield, it may be necessary to add AC line filtering devices, or to mount the drive in a less noisy environment.

Speed adjust potentiometer connections

Warning

Be sure that the potentiometer tabs do not make contact with the potentiometer enclosure. Grounding the input will cause damage to the drive.

Install the circular insulating disk between the mounting panel and the 10K ohm speed adjust potentiometer (see Figure 3). Mount the speed adjust potentiometer through a 0.38-inch (10 mm) hole with the hardware provided. Twist the speed adjust potentiometer wires to avoid picking up unwanted electrical noise.

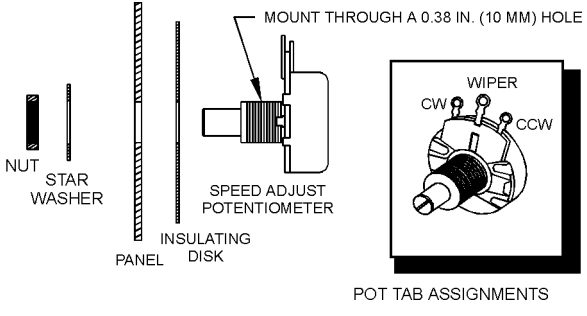


Figure 3. Speed Adjust Potentiometer Installation

Heat sinking

MM20000-series drives require an additional heat sink, p/n 223-0159, when the continuous armature current is above 5 ADC. Apply a thermally conductive heat sink compound (such as Dow Corning® 340 Heat Sink Compound) between the drive chassis and heat sink surface for optimum heat transfer.

Line fusing

Minarik drives require an external fuse for protection. Use fast acting fuses rated for 250 VAC or higher. Table 1 lists the recommended line fuse sizes.

Table 1. Replacement Line Fuse Sizes

90 VDC Motor Horsepower	180 VDC Horsepower	Max. DC Armature Current (amps)	AC Line Fuse Size (amps)
1/20	1/10	0.5	1
1/15	1/8	0.8	1.5
1/8	1/4	1.5	3
1/6	1/3	1.7	3
1/4	1/2	2.6	5
1/3	3/4	3.5	8
1/2	1	5.0	10
3/4	1 1/2	7.6	15
1	2	10	15

Minarik Corporation offers two fuse kits: part number 050–0066 (1–5A Fuse Kit) and 050–0071 (5–15A Fuse Kit). See *Replacement Parts* (page 41) for fuse kit contents.

Connections

Warning

Do not connect this equipment with power applied. Failure to heed this directive may result in fire or serious injury.

Minarik strongly recommends the installation of a master power switch in the voltage input line. The switch contacts must be rated at a minimum of 200% of motor nameplate current and 250 volts.

Connect the power input leads, field output, external line fuse(s) and DC motor to the drive's printed circuit board (PCB) as shown in Figure 4 (page 12).

Motor connections

Minarik drives supply motor voltage from A1 and A2 terminals. It is assumed throughout this manual that, when A1 is positive with respect to A2 , the motor will rotate clockwise (CW) while looking at the output shaft protruding from the front of the motor. If this is opposite of the desired rotation, simply reverse the wiring of A1 and A2 with each other.

Connect a DC motor to PCB terminals A1 and A2 as shown in Figure 4 (page 12). **Ensure that the motor voltage rating is consistent with the drive's output voltage.**

Power connections

Connect the AC line power leads to terminals L1 and L2, or to a double-throw, single-pole master power switch as shown in Figure 4 on page 12 (recommended).

Line fuse connections

Wire an external line fuse between the stop switch (if installed) and the L1 terminal as shown in Figure 4 on page 12. An additional line fuse should be installed on L2 if the input voltage is 230 VAC. The line fuse(s) should be rated at 250 volts and 150 - 200% of maximum motor nameplate current. Refer to the line fuse chart on page 9 for fuse ratings.

Field output connections

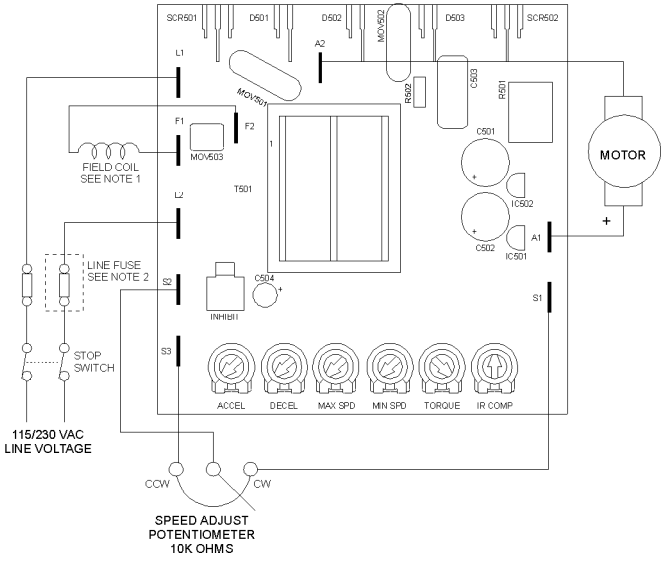
Warning

The field output is for shunt wound motors only. Do not make any connections to F1 and F2 when using a permanent magnet motor.

Use 18 AWG wire to connect the field output to a shunt wound motor as shown in Figure 4 on page 12. See Table 2 for alternate field output connections.

Table 2. Field Output Connections

Line Voltage Motor (VAC)	Approximate Field Voltage (VDC)	Connec Field To
115	50	F1 and L1
115	100	F1 and F2
230	100	F1 and L1
230	200	F1 and F2



NOTES:

1. DO NOT CONNECT FIELD OUTPUT IF USING A PERMANENT-MAGNET MOTOR. REFER TO TABLE 2 (PAGE 11) FOR ALTERNATE FIELD CONNECTIONS.
2. DO NOT ADD A LINE FUSE TO L2 UNLESS LINE VOLTAGE IS 230 VAC.

Figure 4. Power, Fuse and Motor Connections

Voltage follower connection

Instead of using a speed adjust potentiometer, the drive may be wired to follow an analog input voltage signal that is isolated from earth ground (Figure 5). Connect the signal reference (+) to S2. Connect the signal common (–) to S1. Make no connection to S3.

A potentiometer can be used to scale the analog input voltage. An interface device, such as Minarik model PCM4, may be used to scale and isolate an analog input voltage.

With either 115 VAC or 230 VAC line voltage, an analog input voltage range of approximately 0–1.4 VDC is required to produce an armature voltage range of 0–90 VDC. With 230 VAC line voltage, an analog input voltage range of approximately 0–2.8 VDC is required to produce an armature voltage range of 0–180 VDC.

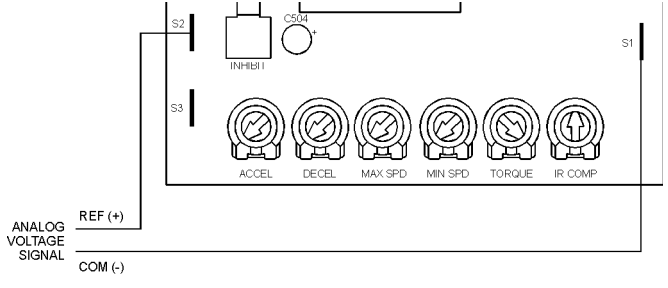


Figure 5. Voltage Follower Connections

Operation

Warning

Dangerous voltages exist on the drive when it is powered. BE ALERT. High voltages can cause serious or fatal injury.

Before applying power

- Verify that no conductive material is present on the printed circuit board.
- Verify that the AC supply is properly balanced.

Drive startup and shutdown

1. Set the reference signal or speed adjust potentiometer to minimum speed.
2. Apply AC line voltage.
3. Slowly turn the speed adjust potentiometer or increase the reference voltage until the desired speed is reached.

To shut down the drive:

To decelerate the motor from set speed to a stop, set the speed adjust potentiometer to zero speed. To coast the motor from set speed to a stop, remove AC line voltage from the drive.

Reversing

Refer to ***Application Notes*** (page 28) for reversing options, or contact your Minarik sales representative.

Starting and Stopping Methods

Warning

For frequent starts and stops, use inhibit mode, or decelerating to a stop (shorting S2 to S1). Do not use any of these methods for emergency stopping. They may not stop a drive that is malfunctioning. Removing AC line power (both L1 and L2) is the only acceptable method for emergency stopping.

Minarik strongly recommends the installation of an emergency stop switch for chassis drives. The switch contacts should be rated at a minimum of 250 volts and 200% of maximum motor current.

Line starting and stopping

When AC line voltage is applied to the drive, the motor accelerates to the set speed. When AC line voltage is removed, the motor coasts to a stop. Line stopping (removing AC line voltage) is recommended for stopping in emergency situations only. It is not recommended for frequent starting and stopping.

Decelerating to minimum speed

The switch shown in Figure 6 may be used to decelerate a motor to a minimum speed. Closing the switch between S1 and S2 decelerates the motor from set speed to a minimum speed determined by the MIN SPD trimpot setting. If the MIN SPD trimpot is set full CCW, the motor decelerates to zero speed when the switch between S1 and S2 is closed. The DECEL trimpot setting determines the rate at which the drive decelerates. By opening the switch, the motor accelerates to set speed at a rate determined by the ACCEL trimpot setting.

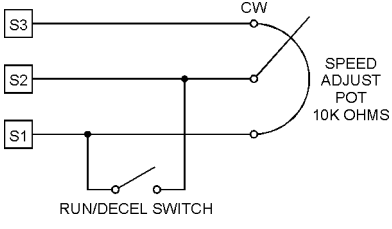


Figure 6. Run / Decelerate to Minimum Speed Switch

Coast to minimum speed using INHIBIT terminals

Short the INHIBIT terminals to coast the motor to minimum speed (Figure 7). Reopen the INHIBIT terminals to accelerate the motor to set speed.

Twist inhibit wires and separate them from other power-carrying wires or sources of electrical noise. Use shielded cable if the inhibit wires are longer than 18 inches (46 cm). If shielded cable is used, ground only one end of the shield to earth ground. Do not ground both ends of the shield.

Minarik Corporation offers two accessory plug harnesses for connecting to the INHIBIT terminals: part number 201-0024 [inhibit plug with 18-inch (46 cm) leads]; and part number 201-0079 [inhibit plug with 36-inch (91 cm) leads].

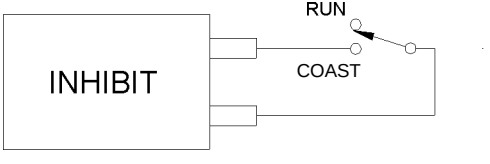


Figure 7. RUN / Coast to Minimum Speed Switch

Dynamic braking

Warning

Wait for the motor to completely stop before switching it back to RUN. This will prevent high armature currents from damaging the motor or drive.

NOTE: For motors rated 1/17 horsepower and lower, a brake resistor is not necessary since the armature resistance is high enough to stop the motor without demagnetization. Replace the dynamic brake resistor with 12 gauge wire.

Dynamic braking may be used to rapidly stop a motor (Figure 8). For the RUN/BRAKE switch, use a double-pole, double-throw switch rated for at least the maximum DC armature voltage and maximum braking current.

Table 3. Recommended Dynamic Brake Resistor Sizes

Motor Armature Current Rating	Minimum Dynamic Brake Resistor Value	Minimum Dynamic Brake Resistor Wattage
Less than 2 ADC	1 ohm	1W
2–3 ADC	5 ohm	5W
3–5 ADC	10 ohm	10W
5–10 ADC	20 ohm	20W
10–17 ADC	40 ohm	50W

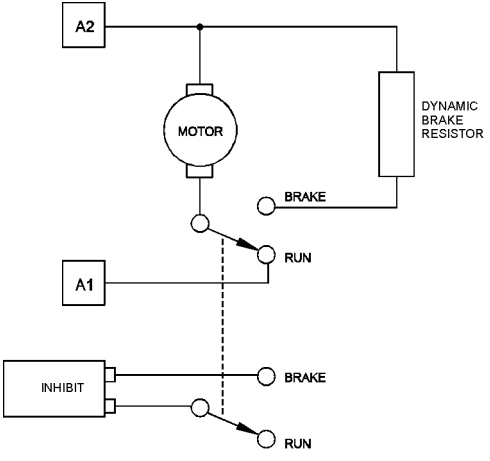


Figure 8. Dynamic Brake Connection

Calibration

Warning

Dangerous voltages exist on the drive when it is powered. When possible, disconnect the voltage input from the drive before adjusting the trimpots. If the trimpots must be adjusted with power applied, use insulated tools and the appropriate personal protection equipment. BE ALERT. High voltages can cause serious or fatal injury.

MM21xx1A and MM22xx1A Series drives have six user-adjustable trimpots. Each drive is factory calibrated to its maximum current rating. Readjust the calibration trimpot settings to accommodate lower current rated motors. See Figure 9 for trimpot location.

All adjustments increase with CW rotation and decrease with CCW rotation. Use a non-metallic screwdriver for calibration. Each trimpot is identified on the printed circuit board.

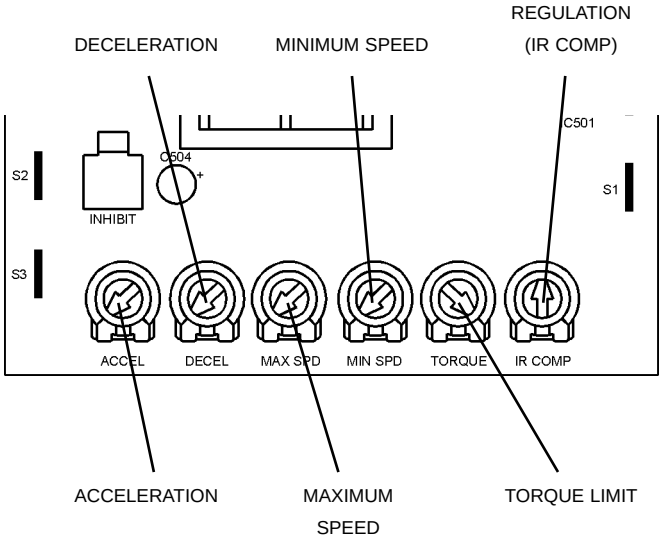


Figure 9. Calibration Trimpot Layout

Calibration procedure

Calibrate the drive using the following procedure:

1. Set the MIN SPD, MAX SPD, ACCEL and DECEL trimpots to zero (full CCW).
2. Set the TORQUE trimpot to maximum (full CW).
3. Set the IR COMP trimpot to midrange (approximate 12 o'clock position).
4. Set the signal input (analog voltage signal or speed adjust potentiometer) to zero.
5. Apply power to the drive.
6. Calibrate the trimpots as follows:

MINIMUM SPEED (MIN SPD)

The MIN SPD setting determines the motor speed when the speed adjust potentiometer is turned full CCW. It is factory set for zero rated speed.

To calibrate, set the MIN SPD trimpot full CCW. Set the speed adjust potentiometer or reference signal to minimum. Adjust the MIN SPD trimpot until the desired minimum motor speed is reached.

MAXIMUM SPEED (MAX SPD)

The MAX SPD setting determines the motor speed when the speed adjust potentiometer is turned full CW. It is factory set for maximum rated speed.

To calibrate, set the MAX SPD trimpot full CCW. Set the speed adjust potentiometer or reference voltage to maximum. Adjust the MAX SPD trimpot until the desired maximum motor speed is reached.

ACCELERATION (ACCEL)

The ACCEL setting determines the time the motor takes to ramp to a higher speed. See ***Specifications*** on page 1 for approximate acceleration times. ACCEL is factory set for the fastest acceleration time (full CCW).

To set the acceleration time:

1. Set the speed adjust potentiometer or reference signal to minimum. The motor should run at minimum speed.
2. Set the speed adjust potentiometer or reference signal to maximum and measure the time it takes the motor to go from minimum to maximum speed.
3. If the time measured in step 2 is not the desired acceleration time, turn the ACCEL trimpot CW for a slower acceleration time, or CCW for a faster acceleration time. Repeat steps 1 through 3 until the acceleration time is correct.

DECELERATION (DECEL)

The DECEL setting determines the time the motor takes to ramp to a lower speed. See ***Specifications*** on page 1 for approximate deceleration times. DECEL is factory set for the fastest deceleration time (full CCW).

To set the deceleration time:

1. Set the speed adjust potentiometer or reference signal to maximum. The motor should run at maximum speed.
2. Set the speed adjust potentiometer or reference signal to minimum and measure the time it takes the motor to go from maximum to minimum speed.
3. If the time measured in step 2 is not the desired deceleration time, turn the DECEL trimpot CW for a slower deceleration time, or CCW for a faster deceleration time. Repeat steps 1 through 3 until the deceleration time is correct.

REGULATION (IR COMP)

The IR COMP trimpot setting determines the degree to which motor speed is held constant as the motor load changes. It is factory set for optimum motor regulation.

To calibrate IR COMP (exact calibration):

1. Turn the IR COMP trimpot full CCW.
2. Set the speed adjust potentiometer until the motor runs at midspeed without load (for example, 900 RPM for an 1800 RPM motor) A hand held tachometer may be used to measure motor speed.
3. Load the motor armature to its full load armature current rating. The motor should slow down.
4. While keeping the load on the motor, rotate the IR COMP trimpot until the motor runs at the speed measured in step 2.

Approximate calibration:

If the motor does not maintain set speed as the load changes, gradually rotate the IR COMP trimpot CW. If the motor oscillates (overcompensation), the IR COMP trimpot may be set too high (CW). Turn the IR COMP trimpot CCW to stabilize the motor speed. See Figure 10 (page 27) for typical IR COMP and TORQUE trimpot settings.

TORQUE LIMIT (TORQUE)

Warning

Although TORQUE LIMIT is set to 120% of maximum drive current rating, continuous operation beyond that rating may damage the motor. If you intend to operate beyond the rating, contact your Minarik representative for assistance.

The TORQUE setting determines the maximum torque for accelerating and driving the motor. TORQUE is factory set at 120% of maximum drive current. You must recalibrate the TORQUE setting if using a lower current rated motor.

1. With no power applied to the drive, connect a DC ammeter in series with the motor armature.
2. Set the TORQUE trimpot to full CCW.
3. Carefully lock the motor armature. Ensure that the motor is firmly mounted.
4. Apply line power. The motor should be stopped.
5. Set the speed potentiometer or reference signal to maximum speed. The motor should remain stopped.
6. Slowly rotate the TORQUE trimpot clockwise (CW) until the ammeter reads 120% of maximum motor armature current.
7. Set the speed adjust potentiometer or reference signal to zero speed.
8. Remove power from the drive.
9. Remove the lock from the motor shaft.
10. Remove the ammeter in series with the motor armature.

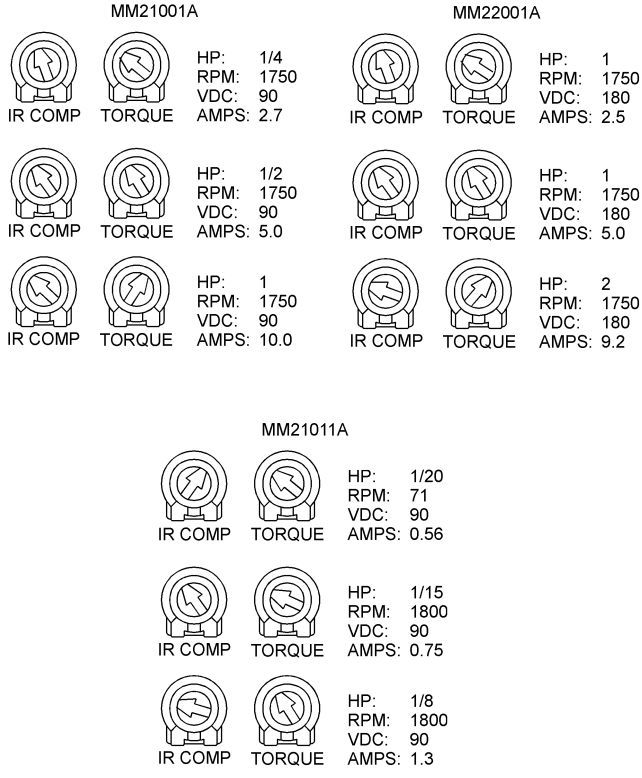


Figure 10. Typical IR COMP and TORQUE Settings (settings may vary by application)

Application Notes

FWD-STOP-REV switch

Use a three-pole, three-position switch with a single speed adjust potentiometer to coast to a stop between reversals (Figure 11). Set the switch to the center position to decelerate the motor to a stop. The switch contacts should be rated at a minimum of 250 volts and 150% to 200% of motor nameplate current.

Wait for the motor to come to a stop before switching to either the forward or reverse direction. This will prevent high armature currents from damaging the motor or drive.

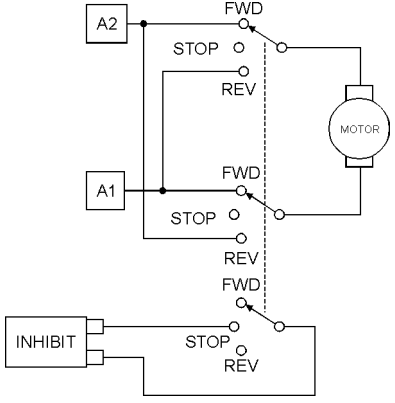


Figure 11. FWD-STOP-REV Switch

Reversing with dynamic braking

A dynamic brake may be used when reversing the motor direction (Figure 12). Use a three-pole, three-position switch rated for at least the maximum DC armature voltage and maximum braking current. Wait for the motor to stop completely before switching it to either the forward or reverse direction.

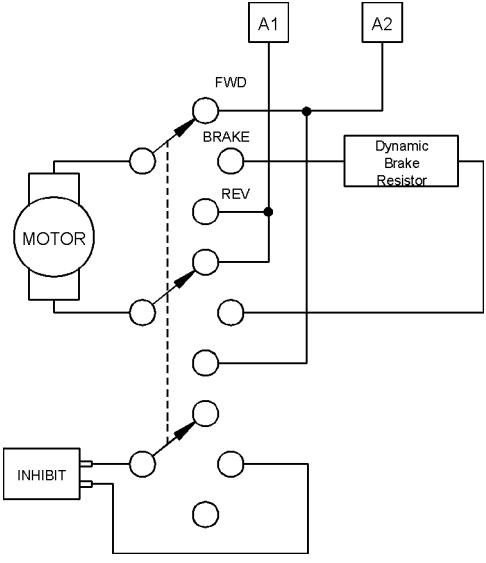


Figure 12. Reversing Circuit Connection

Reversing with a DLC600

DIGI-LOK controller DL600 can be used in a reversing application. The controller must be inhibited while braking. Without the inhibit feature, the controller will continue to regulate, causing overshoot when the DIGI-LOK is switched back to the drive.

Figure 13 shows the connection of the reversing circuit to an MM20000 series drive and a DLC600. Only one feedback device (encoder or magnetic pickup) may be used at any time.

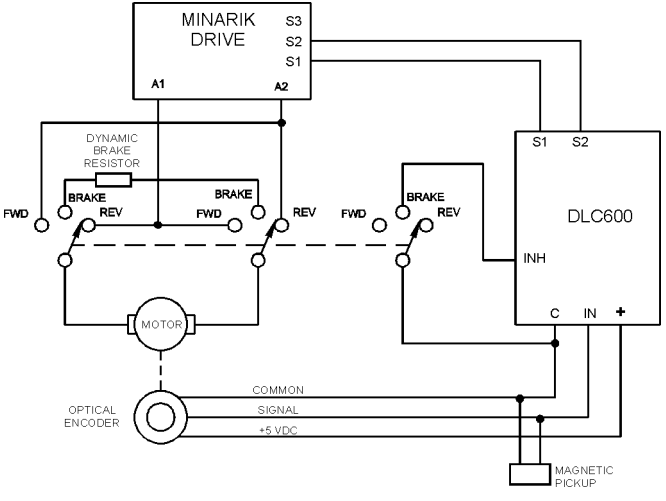


Figure 13. Reversing with a DLC600

Independent adjustable speeds

Connect two speed adjust potentiometers with a single pole two position switch to select between two independent speeds shown in the forward direction (Figure 14). The speed adjust potentiometers can be mounted at two separate operating stations.

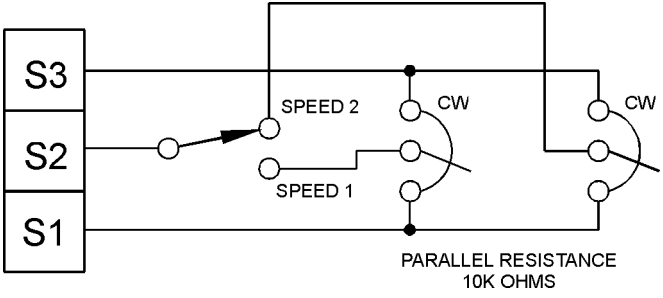


Figure 14. Independent Adjustable Speeds

Adjustable speeds using potentiometers in series

Replace the speed adjust potentiometer with a single-pole, multi-position switch, and two or more potentiometers in series, with a total series resistance of 10K ohms. Figure 15 shows a connection for fixed high and low speed adjust potentiometers.

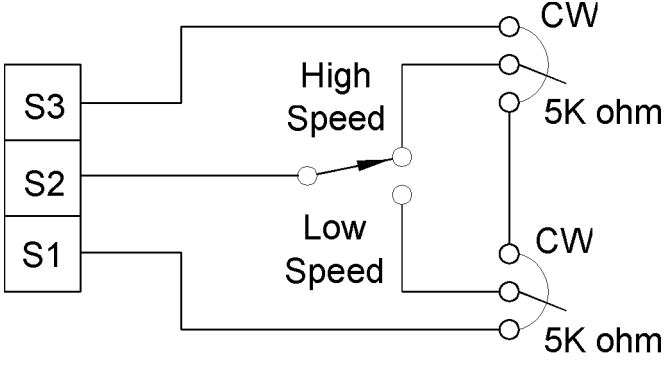


Figure 15. Adjustable Fixed Speeds Using Potentiometers in Series

Multiple fixed speeds

Replace the speed adjust potentiometer with series resistors with a total series resistance of 10K ohms (Figure 16). Add a single pole, multi-position switch with the correct number of positions for the desired number of fixed speeds.

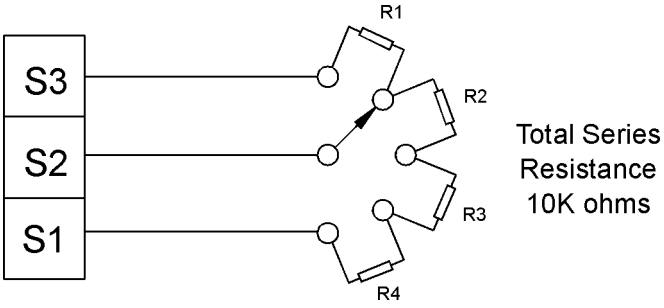


Figure 16. Multiple Fixed Speeds

RUN/JOG switch

Using a RUN/JOG switch is recommended in applications where quick stopping is not needed and frequent jogging is required. Use a single pole, two position switch for the RUN/JOG switch, and a single pole, normally closed, momentary operated pushbutton for the JOG pushbutton as shown in Figure 17. When the RUN/JOG switch is set to JOG, the motor decelerates to zero speed. Press the JOG pushbutton to jog the motor. Return the RUN/JOG switch to RUN for normal operation.

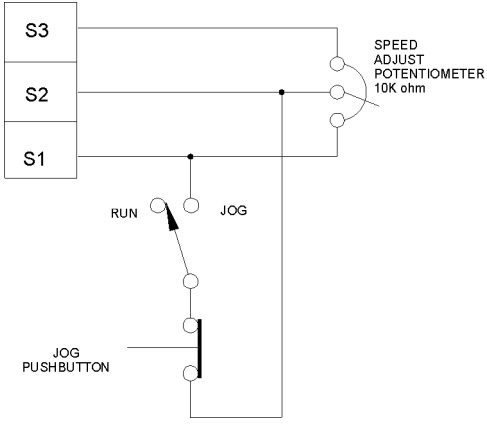


Figure 17. RUN/JOG Switch Connection to Speed Adjust Potentiometer

Leader-follower application

In this application, use a PCM4 to monitor the speed of the leader motor (Figure 18). The PCM4 isolates the leader motor from the follower drive, and outputs a voltage proportional to the leader motor armature voltage. The follower drive uses this voltage reference to set the speed of the follower motor. An optional ratio potentiometer may be used to scale the PCM4 output voltage.

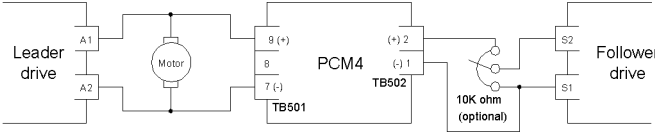


Figure 18. Leader-Follower Application

Single speed potentiometer control of multiple drives

Multiple drives can be controlled with a single speed adjust potentiometer using a PCM4 at the input of each drive to provide isolation (Figure 19). Optional ratio potentiometers can be used to scale the PCM4 output voltage, allowing independent control of each drive.

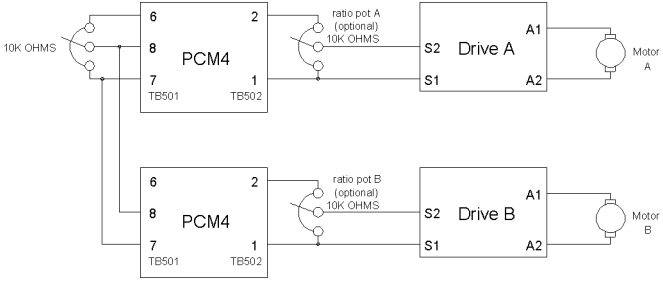


Figure 19. Single Speed Potentiometer Control of Multiple Drives

Troubleshooting

Warning

Dangerous voltages exist on the drive when it is powered. When possible, disconnect the drive while troubleshooting. High voltages can cause serious or fatal injury.

Before troubleshooting

Perform the following steps before starting any procedure in this section:

- Disconnect AC line voltage from the drive.
- Check the drive closely for damaged components.
- Check that no conductive or other foreign material has become lodged on the printed circuit board.
- Verify that every connection is correct and in good condition.
- Verify that there are no short circuits or grounded connections.
- Check that the drive's rated armature outputs are consistent with the motor ratings.

For additional assistance, contact your local Minarik distributor, or the factory direct:
(800) MINARIK (phone) or (800) 394-6334 (fax).

Symptom	Possible Causes	Suggested Solutions
Line fuse blows	1. Line fuses are the wrong size. 2. Motor cable or armature is shorted to ground. 3. Nuisance tripping caused by a combination of ambient conditions and high-current spikes. 4. Field circuit is shorted.	1. Check that line fuses are the proper size. 2. Check motor cable and armature for shorts. 3. Add a blower to cool the drive components; decrease TORQUE settings, **or** resize motor and drive for actual load demand, **or** check for incorrectly aligned mechanical components or "jams". See page 26 for information on adjusting the TORQUE trimpot. 4. Send in drive to Minarik repair department.
Line fuse does not blow, but the motor does not run	1. Reference signal or speed adjust pot is set to zero speed. 2. Reference signal or speed adjust potentiometer connections are open.	1. Increase reference signal or speed adjust potentiometer setting. 2. Check that the reference signal or speed adjust potentiometer connections are not open.

Symptom	Possible Causes	Suggested Solutions
Line fuse does not blow, but the motor does not run (cont.)	3. Drive is overloaded. 4. Drive is not receiving AC line voltage. 5. Motor is not connected.	3. Verify that the motor is not jammed. Increase TORQUE setting (page 26). 4. Apply AC line voltage to L1 and L2. 5. Connect motor to A1 and A2.
Motor runs too fast at maximum speed setting	1. MIN SPD and MAX SPD settings are too high. 2. Field connections are loose (shunt-wound motors only)	1. Recalibrate MIN SPD (page 22) and MAX SPD (page 23). 2. Check field connections
Motor runs too slow or too fast	MIN SPD and MAX SPD are not calibrated.	1. Recalibrate MIN SPD (page 22) and MAX SPD (page 23).
Motor will not reach the desired speed.	1. MAX SPD setting is too low. 2. IR COMP setting is too low. 3. Motor is overloaded.	1. Increase MAX SPD setting (page 23). 2. Increase IR COMP setting (page 25). 3. Check motor load. Resize the motor if necessary.

Symptom	Possible Causes	Suggested Solutions
Motor pulsates or surges under load	1. IR COMP is set too high. 2. Control is in current limit mode.	1. Adjust the IR COMP setting slightly CCW until the motor speed stabilizes (page 25). 2. Check that motor is of sufficient horsepower and amperage.

Replacement Parts

Replacement parts are available from Minarik Corporation and its distributors for this drive series.

Table 4. Replacement Parts

Model No.	Symbol	Description	Minarik P/N
MM21001A	C501–502	220 uF, 35 VDC Capacitor	011-0027
	D501–503	1N5406 Diode	071-0007
	SCR501–502	S8020L High-power SCR	072-0043
	R501	0.05 Ohm, 3W Resistor	032-0073
	T501	ST-3-3109 Transformer	230-0083
		Chassis	222-0079
		10K Ohm Pot Kit	202-0031
MM22001A	Same as MM21011A except:		
	R501	0.01 Ohm, 5W Resistor	032-0129

202-0031 POTENTIOMETER KIT CONTENTS

Description	Minarik P/N
1 EA 10K OHM Potentiometer, 5W, 5% TOL	120-0009
1 EA 3/8-32 X 1/2 NUT	151-0007
1 EA 3/8IN INT TOOTH LOCK WSHR	152-0007
1 EA POT INSULATING WASHER	156-0022
9 EA NON-INSULATED FEMALE TAB 1/4IN	163-0028

FUSE KIT CONTENTS

1 -5A FUSE KIT (050-0066)

Description	Minarik P/N
2 EA 1 AMP 3AG FAST-ACTING FUSE	050-0042
2 EA 1-1/2 AMP 3AG FAST-ACTING	050-0026
2 EA 3 AMP 3AG FAST-ACTING FUSE	050-0021
2 EA 5 AMP 3AG FAST-ACTING FUSE	050-0022

5 - 15A FUSE KIT (050-0071)

Description	Minarik P/N
2 EA 5 AMP 3AG FAST-ACTING FUSE	050-0022
2 EA 8 AMP 3AG FAST-ACTING FUSE	050-0059
2 EA 10 AMP 3AB NORMAL-BLO FUSE	050-0024
2 EA 15 AMP 3AB NORMAL-BLO FUSE	050-0018

Certificate of Compliance

Minarik Corporation hereby certifies that its MM21000A series drives have been approved to bear the “CE” mark provided the conditions of approval (listed in Exhibit “A”) have been met by the end user.

The MM20000 series has been tested to the following test specifications:

EN55011:1991 (emissions), and
EN50082-1:1992 (immunity)

Compliance allows Minarik’s MM21000 series to bear the CE mark.

The end user, as described herein, falls into one of two categories:

1. The Consumer will deploy a stand-alone unit as an integral, yet external, portion of the machine being operated.
2. The Original Equipment Manufacturer (OEM) will implement the product as a component of the machine being manufactured.

Exhibit “A”

In addition to EMI/RFI safeguards inherent in the MM20000 series’ design, external filtering is required.

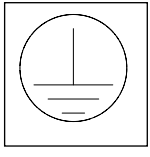
Minarik requires the Corcom® filters listed in Table 5. If the exact filter is not available, the specifications are as follows:

L = (1.73 + 0.03) milliHenries.
C = (0.27 + 0.54) microFarads (X); 0.0055 microFarads (Y).
R = 330Kohms.
Rated current: 1.4 times maximum DC motor current.
Filter type: Balanced 2-section.

Table 5. Corcom Filters

Nameplate Current of Motor Wired to the Drive	Corcom Filter Part Number
0 to 4 amps	6VV1
4.1 to 13 amps	20VV1

The filters in Table 5 should be wired to the AC line within 0.25 meters of the drive. The ground connection from the filter must be wired to solid earth ground (resistance less than 500 ohms); not machine ground. This is very important!



If the end-user is using a CE-approved motor, the correct filter from Table 5 (page 45) is all that is necessary to meet the EMC directives listed herein.

If the end-user is not using a CE-approved motor, a second filter, part number CEXXMM, must be deployed on the output. XX = rated current of the filter.

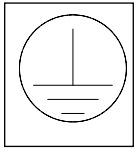
The CE20MM is a Real-Pole Balanced-Pi 3-pole filter. If the exact filter is not available, the specifications are as follows:

L & L1 = 2 * (0.8) milliHenries.
C & C1 = 2 * (0.1) microFarads @ 400W VDC.
R_{in} = 0.1 ohm; R_{out} = 1.2 ohm.

Table 6. Minarik Filters

Nameplate Current of Motor Wired to the Drive	Minarik Filter Part Number
0 to 4 amps	CE4MM
4.1 to 13 amps	CE20MM

The filters in Table 6 must be wired to the DC output of the drive, as close to the drive as possible. The ground connection from the filter must be wired to solid earth ground (resistance less than 500 ohms); not machine ground. This is very important!



The end user must use the filtration listed in Exhibit A to comply with CE. The OEM may choose to provide alternative filtering that encompasses the Minarik drive and other electronics within the same panel.

The OEM has this liberty because CE is a machinery directive. Whether or not every component in the OEM's machinery meets CE, the OEM must still submit his machine for CE approval. Thus, no component must necessarily meet CE within the machine, as long as the OEM takes the necessary steps to guarantee the machine does meet CE. By the same token, even if every component in the OEM's machine does meet CE, the machine will not necessarily meet CE as a machine.

Using CE-approved wiring practices (like proper shielding) and the filters listed in Exhibit A guarantee the drive will meet EN55011 (1991 emissions standard) and EN50082-1 (1992 immunity standard).

Unconditional Warranty

A. Warranty

Minarik Corporation (referred to as "the Corporation") warrants that its products will be free from defects in workmanship and material for twelve (12) months or 3,000 hours, whichever comes first, from date of manufacture thereof. Within this warranty period, the Corporation will repair or replace, at its sole discretion, such products that are returned to Minarik Corporation, 901 East Thompson Avenue, Glendale, CA 91201-2011 USA.

This warranty applies only to standard catalog products, and does not apply to specials. Any returns for special controls will be evaluated on a case-by-case basis. The Corporation is not responsible for removal, installation, or any other incidental expenses incurred in shipping the product to and from the repair point.

B. Disclaimer

The provisions of Paragraph A are the Corporation's sole obligation and exclude all other warranties of merchantability for use, express or implied. The Corporation further disclaims any responsibility whatsoever to the customer or to any other person for injury to the person or damage or loss of property of value caused by any product that has been subject to misuse, negligence, or accident, or misapplied or modified by unauthorized persons or improperly installed.

C. Limitations of Liability

In the event of any claim for breach of any of the Corporation's obligations, whether express or implied, and particularly of any other claim or breech of warranty contained in Paragraph A, or of any other warranties, express or implied, or claim of liability that might, despite Paragraph B, be decided against the Corporation by lawful authority, the Corporation shall under no circumstances be liable for any consequential damages, losses, or expense arising in connection with the use of, or inability to use, the Corporation's product for any purpose whatsoever.

An adjustment made under warranty does not void the warranty, nor does it imply an extension of the original 12-month warranty period. Products serviced and/or parts replaced on a no-charge basis during the warranty period carry the unexpired portion of the original warranty only.

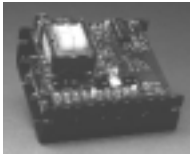
If for any reason any of the foregoing provisions shall be ineffective, the Corporation's liability for damages arising out of its manufacture or sale of equipment, or use thereof, whether such liability is based on warranty, contract, negligence, strict liability in tort, or otherwise, shall not in any event exceed the full purchase price of such equipment.

Any action against the Corporation based upon any liability or obligation arising hereunder or under any law applicable to the sale of equipment or the use thereof, must be commenced within one year after the cause of such action arises.

Other drives from Minarik Corporation:

NRGD Series

DLC600



MMRGD Series

BOSS Series

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